YEAR-END REPORT
FOR THE 2004 FIELD SEASON
AT LEVIATHAN MINE

Alpine County, California

February 2005

Prepared by:
California Regional Water Quality Control Board, Lahontan Region

To comply with:
Paragraph No. 35 of USEPA's July 19, 2000 Administrative Abatement Action, as amended.

LEVIATHAN MINE
YEAR-END REPORT FOR 2004 FIELD SEASON

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Section

1. BACKGROUND

Leviathan Mine is an inactive sulfur mine that the State of California acquired in the early 1980s in order to clean up water quality problems caused by historic mining. Jurisdiction over Leviathan Mine rests with the State Water Resources Control Board (SWRCB), which, in turn, has delegated jurisdiction over clean up work to the California Regional Water Quality Control Board, Lahontan Region (RWQCB).

The former sulfur mine is located on the eastern slope of the Sierra Nevada Mountains in Alpine County, California, in the upper portions of the Bryant Creek watershed, as shown in Figure 1. The current boundary of the Leviathan Mine site encompasses thirty-two patented mineral claims and a patented mill site, which together total 656.09 acres. The state-owned portion of the Leviathan Mine site encompasses approximately 475.70 acres. Mining disturbance is evident is on approximately 231 acres. The majority of mining disturbance is on state-owned property, with approximately 21 acres of disturbance found on property owned by the United States Department of Agriculture, Forest Service, Humboldt-Toiyabe National Forest (USFS). Leviathan Mine is approximately six miles east of Markleeville, California and five miles west of Topaz Lake, Nevada. The USFS owns the majority of surrounding land, with the exception of ten private parcels along the southern boundary of the mine site.

As shown in Figure 2, Leviathan and Aspen creeks flow across the mine site and eventually join just below the mine. Approximately 1.5 miles downstream of the confluence of Leviathan and Aspen creeks, Leviathan Creek joins Mountaineer Creek. The combined flow of Leviathan and Mountaineer creeks forms Bryant Creek. Approximately 3.5 miles downstream of the confluence of Leviathan and Mountaineer creeks, Bryant Creek flows across the Nevada state line. Approximately 1.8 miles downstream of the Nevada state line there exists an irrigation structure that enables the diversion of water from Bryant Creek to an irrigation ditch. The irrigation ditch is used seasonally to divert flow from Bryant Creek to the River Ranch property, owned by Park Cattle Company. From the irrigation diversion, the natural course of Bryant Creek continues to the northwest, and approximately 1.5 miles downstream from the irrigation diversion, Bryant Creek joins the East Fork of the Carson River.

Historic mining activities at Leviathan Mine included underground and open pit extraction of sulfur. These activities resulted in the exposure of certain minerals (e.g. pyrite) contained in the native soil and rock, to air and water. This exposure triggers a series of chemical reactions that cause the ground water to become acidic. As the acidic ground water moves through the soil and around rocks, it dissolves metals in the ground. Eventually, the acidic ground water encounters the ground surface in the form of a seep or spring. Acidic and metal rich water seeping out of the ground is referred to as Acid Mine Drainage (AMD). If left unabated, the AMD enters nearby creeks (Leviathan and Aspen) causing significant adverse impacts. In addition, historic mining activities resulted in significant soil disturbance, erosion, and sediment deposition to nearby receiving waters.

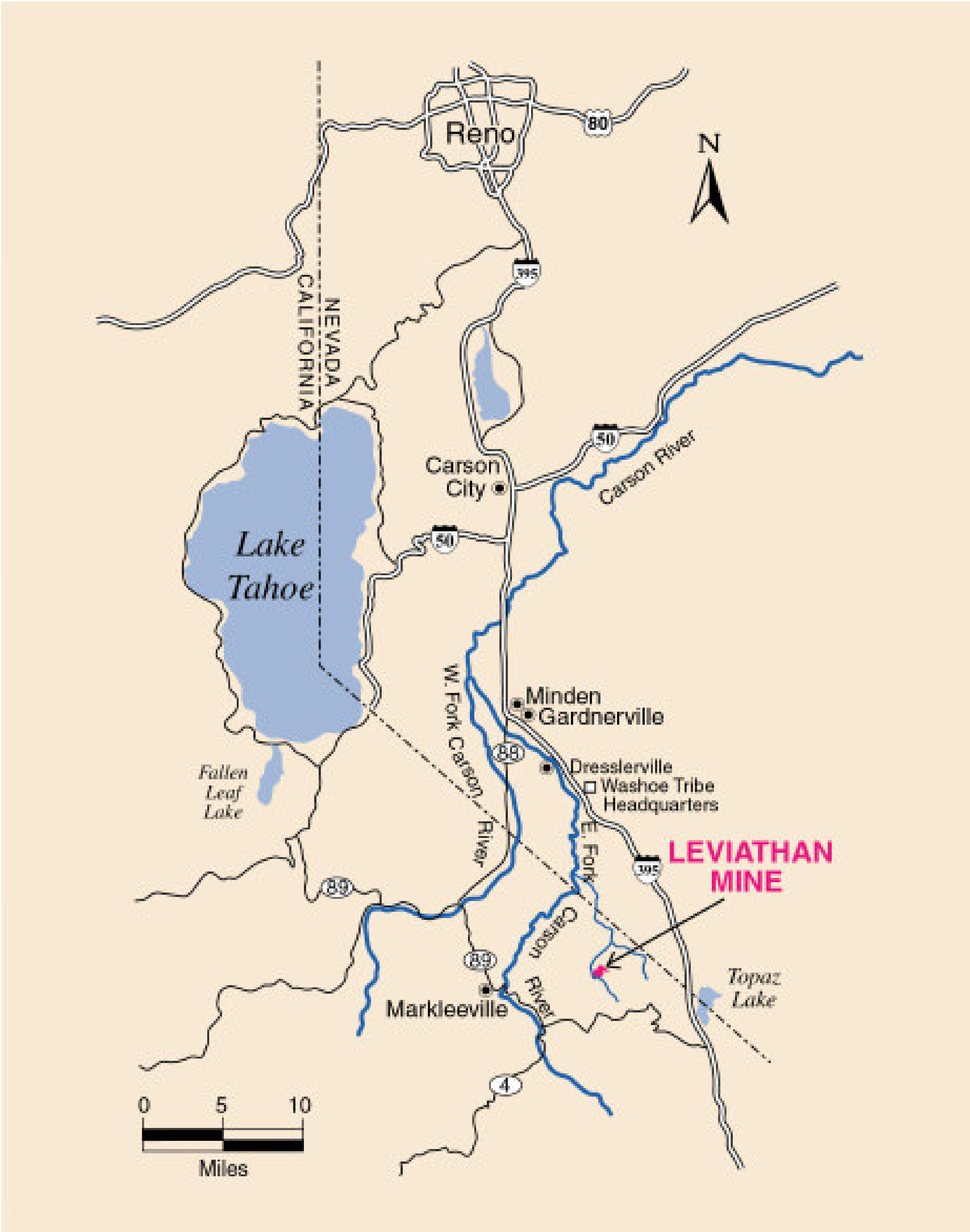

FIGURE 1
SITE LOCATION

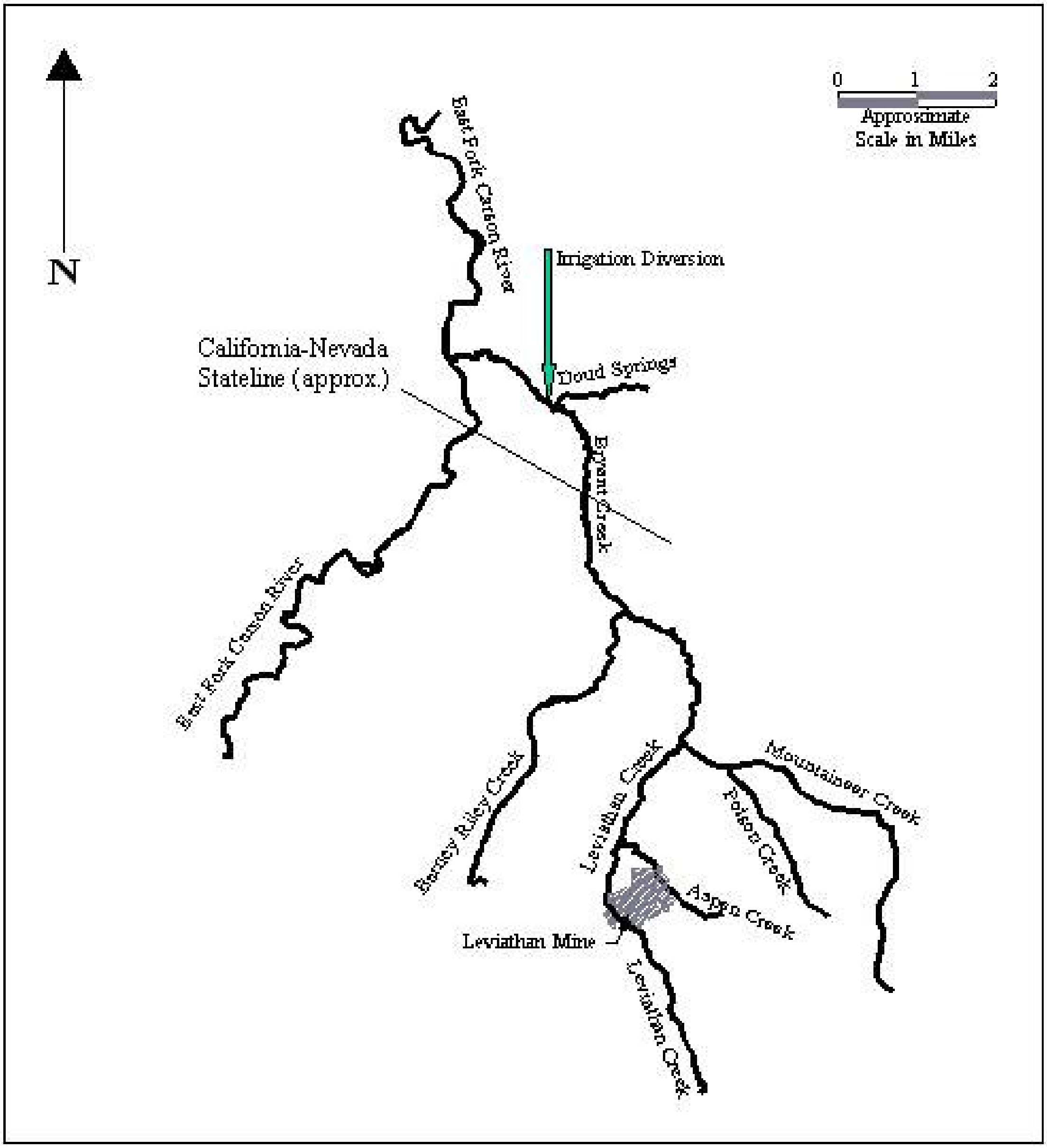

Figure 2. Leviathan Creek and Receiving Waters

Acting on the State's behalf, the RWQCB has implemented several projects to abate and quantify the discharge of pollutants from Leviathan Mine. In 1985, the RWQCB completed construction of a pollution abatement system at Leviathan Mine to address specific problem areas. The 1985 project reduced the pollutant load to receiving waters; however, the project was not intended to address all sources of pollution.

In May 2000, the United States Environmental Protection Agency (USEPA) placed Leviathan Mine on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List, thus making Leviathan Mine a federal Superfund site. Because the State of California is the present property owner, USEPA has identified the State as a Potentially Responsible Party. USEPA may direct Potentially Responsible Parties to take certain actions to characterize and abate pollution at Superfund sites.

On July 19, 2000, pursuant to its authority under CERCLA, USEPA issued an Administrative Abatement Action (AAA) to the RWQCB and, thereby, directed the RWQCB to implement certain pollution abatement and site characterization activities at Leviathan Mine. With only slight modification, USEPA reissued the AAA in 2001, 2002, 2003, and again in 2004. It is expected that USEPA will continue to direct RWQCB work at Leviathan Mine through annual reissues of the AAA, until a remedy addressing all releases of hazardous substances at Leviathan Mine is implemented (potentially by other parties).

2. 2004 RWQCB ACTIVITIES

RWQCB activities for the 2004 field season included: 1) treatment of AMD held in evaporation ponds (pond water treatment); 2) continued implementation of surface water monitoring; and 3) site maintenance. The RWQCB conducted each of the above-listed activities in accordance with *Work Plan for 2004 Site Work by the California Regional Water Quality Control Board at Leviathan Mine* (Work Plan) transmitted to USEPA on May 17, 2004.

3. POND WATER TREATMENT

3.1 Background

As mentioned previously, the RWQCB completed a pollution abatement system at Leviathan Mine in 1985 that addressed specific problem areas. The 1985 abatement system included construction of five lined evaporation ponds (see Figure 3) to capture and evaporate AMD from remnant underground mine workings. The primary sources of AMD to the pond system are the "Adit" and the Pit Under-Drain.

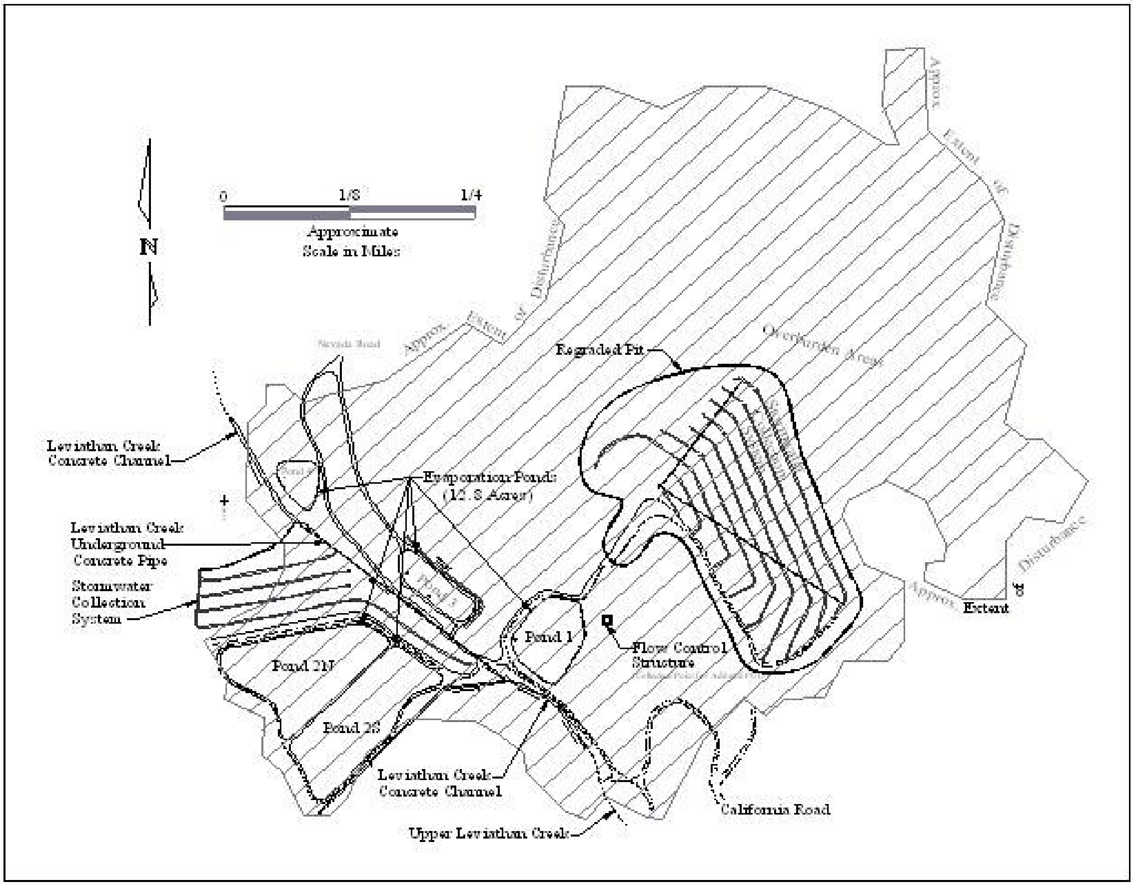

Figure 3. 1985 Site Improvements

The Adit is a remnant tunnel from underground mining activities that occurred in the 1930s. The exact condition of the interior of the Adit is unknown, but it is likely that portions of the tunnel have collapsed. The tunnel extends from a point approximately 80 feet east of Pond 1 in an easterly direction, beneath the floor of the open pit, to a point approximately 1,000 feet on the east side of the open pit. The Adit intercepts and conveys groundwater in a westerly direction, towards the evaporation pond system. Acidic groundwater from the Adit has a pH of less than 3.0 and typically has a flow rate between 9 and 21 gallons per minute (based on USGS data since 1999). As part of the State's 1985 pollution abatement project, the State installed an underground drain to collect acidic groundwater emanating from the Adit. The underground drain consists of 12-inch perforated pipe positioned in a bed of drain rock having approximate dimensions 8-feet wide, 15-feet long, and 3-feet deep. The bed of drain rock is located at the collapsed westerly end of the Adit, approximately 80 feet east of Pond 1, and approximately 10 feet above the overflow elevation of Pond 1. The underground drain is completely buried in native material. The perforated pipe is connected to a non-perforated 12-inch pipe that carries the acidic drainage to a concrete box in which the drainage can be routed to the evaporation pond system or to Leviathan Creek.

The State installed the Pit Under-Drain (PUD) during construction of the 1985 pollution abatement project to dewater saturated soils in the bottom of the open pit. Dewatering of the pit bottom was necessary for completion of excavation work in the pit. The PUD consists of approximately 1,900 linear feet of collector piping in the floor of the open pit. The collector piping consists of a 12-inch perforated pipe laid in a 3-foot by 3-foot trench filled with drain rock. The depth of the collector pipes is no greater than 30 feet below the elevation of the pit bottom. The collector pipes are completely buried in pit backfill material. The collector pipes eventually connect to a non-perforated 18-inch pipe that carries subsurface drainage from the PUD to a concrete box in which the drainage can be routed to the evaporation pond system or to Leviathan Creek (the same box that the Adit is carried to). Acidic drainage from the PUD has a pH of less than 3.0 and typically has a flow rate between 0.1 and 5 gallons per minute (based on data since 1999).

Given the limited usable area at the mine site, the evaporation ponds could not be sized to provide 100 percent containment of influent flows (consisting of AMD from the Adit and PUD, and direct rain/snow onto the ponds). The evaporation ponds cover a cumulative surface area of approximately 12.8 acres with a cumulative holding capacity of approximately 16 million gallons (based on an October 1998 survey conducted by ARCO Environmental Remediation, LLC). During the time period between November 1 and June 1, the Adit and PUD will contribute approximately 4.5 million gallons (assuming an average flow rate of 15 gpm) and direct rain/snow will contribute approximately 5.2 million gallons (assuming 15 inches of rain/snow) to the pond system, for a total of 9.7 million gallons. The ponds are likely to overflow if 9.7 million gallons of storage capacity are not available in the pond system on November 1. The evaporation ponds were intended to prevent the discharge of AMD until the flow in receiving waters was expected to provide the greatest attenuation of discharge effects. Following completion of the 1985 project and up until 1999, discharge of AMD from the pond system (pond overflow) routinely occurred during the spring months when pond inflow exceeded the storage and evaporative capacities of the pond system.

To prevent pond overflows, the RWQCB assessed a treatment process that enabled the treatment and discharge of treated pond water during the summer months to increase pond storage capacity for the subsequent winter and spring months. The RWQCB assembled a treatment system during the 1999 field season on the north east corner of Pond 1 and tested the process at full-scale during the 1999 and 2000 field seasons. The typical field season at Leviathan Mine runs from mid-June through mid-October. The RWQCB successfully operated the treatment system during the 2001 through 2004 field seasons and the ponds have not overflowed since initiation of the RWQCB's summer treatment program in 1999.

The process employed by the RWQCB for the treatment of AMD contained in the pond system can be described as biphasic neutralization. In this process, a source of alkalinity, such as calcium hydroxide, is mixed into the AMD (from the pond system) at two distinct points in the process. The addition of alkalinity causes a series of beneficial chemical reactions including an increase in pH and the precipitation of dissolved constituents (including metals) contained in the AMD. The precipitated metals are then separated from the solution, and the final product is a nearly metal-free effluent, with near neutral pH, and waste sludge.

The biphasic neutralization process had been identified through laboratory and field-testing as a means to treat pond water, produce high quality effluent, and control the quality of the waste sludge produced by the process. While the neutralization of AMD by the addition of alkalinity has long been accepted as an effective means to raise pH and remove metals in AMD, laboratory and field-testing of pond water demonstrated that neutralization of pond water by adding alkalinity at one point in the process (monophasic neutralization) would produce a large volume of sludge that would be considered hazardous by California standards. Laboratory and field-testing demonstrated that the sludge produced by monophasic neutralization would exceed the Total Threshold Limit Concentration (TTLC) for arsenic (As). When the total concentration of any constituent equals or exceeds its TTLC, by California standards, the waste is considered to be hazardous. Biphasic neutralization (adding alkalinity at two points in the process) provides a means to treat pond water and significantly reduce the volume of hazardous sludge generated by the process.

The biphasic process consists of neutralizing AMD by the addition of lime (calcium hydroxide [$Ca(OH)_2$]) at two points in the treatment process. Sludge is produced in both phases of the biphasic process. While sludge generated during the first phase of treatment of pond water exhibits hazardous characteristics, based on the concentration of As, the volume of Phase 1 sludge is relatively low. During the 2004 treatment season, Phase 1 sludge comprised approximately 10 percent of the total volume of sludge and Phase 2 sludge comprised approximately 90 percent of the total volume of sludge generated from the process.

In the first phase of the biphasic process, lime is added to raise the pH from 2.5 to approximately 2.8. At this pH, dissolved iron (Fe) in the AMD precipitates out of solution as iron hydroxide ($Fe[OH]_3$). During this precipitation, the As "co-precipitates" or is adsorbed to the $Fe(OH)_3$ to form Phase 1 sludge. In the second phase of the biphasic process, additional lime is added to raise the pH of the partially treated AMD to approximately 8.5. This increase in pH causes the remaining metals to precipitate out of solution as metal hydroxides, forming Phase 2 sludge. Phase 2 sludge is typically non-hazardous. Periodically, Ni has been detected in Phase 2 sludge at concentrations in excess of the STLC; however, testing has demonstrated that the incorporation of dry lime into the Phase 2 sludge will render Phase 2 sludge passable under STLC. The process of adding dry lime to Phase 2 sludge will occur as Phase 2 sludge is removed from the Pit Clarifier during the 2005 field season. The bulk of Phase 2 sludge is made up of gypsum (calcium sulfate [$CaSO_4$]). In the current configuration, Phase 1 sludge is disposed at an offsite hazardous waste disposal facility and the Phase 2 sludge is disposed onsite (in the mine pit).

Discharge from the biphasic treatment system to Leviathan Creek had to comply with discharge standards in USEPA's 2004 Removal Action Memo, as shown in Table 1.

Table 1. 2004 Discharge Criteria for Biphasic Treatment

Water Quality Parameter	**MAXIMUM**	**AVERAGE**
pH	--	Between 6.0 – 9.0 SU$_{f2}$
Arsenic	0.34 mg/l$_{f1}$	0.15 mg/l$_{f4}$
Aluminum	4.0 mg/l$_{f1}$	2.0 mg/l $_{f4}$
Cadmium	0.009 mg/l$_{f1}$	0.004mg/l $_{f4}$
Chromium	0.97 mg/l$_{f1}$	0.31 mg/l $_{f4}$
Copper	0.026 mg/l$_{f1}$	0.016 mg/l $_{f4}$
Iron	2.0 mg/l$_{f1}$	1.0 mg/l $_{f4}$
Lead	0.136 mg/l$_{f1}$	0.005 mg/l$_{f4}$
Nickel	0.84 mg/l$_{f1}$	0.094 mg/l $_{f4}$
Selenium (Total Recoverable)	Not Promulgated$_{f3}$	0.005 mg/l $_{f4}$
Zinc	0.21 mg/l$_{f1}$	0.21 mg/l $_{f4}$

f1 Dissolved concentration in a daily grab sample that has been field-filtered (0.45 micron) and acid fixed.
f2 pH measurement based on 24-hour average discharge.
f3 Total recoverable concentration in a daily grab sample that is acid fixed, but not filtered.
f4 The sum of the detected concentration in four daily grab samples, from four consecutive discharge days, divided by four.

3.2 Biphasic Process Flow Description

A 5-horsepower (hp) electric pump conveyed AMD from Pond 1 to a 10,000-gallon fiberglass Phase 1 reaction tank (R-1). A pH probe installed in R-1 measured pH in R-1 and controlled the amount of lime slurry added to R-1. A 3-hp mixer on R-1 mixed AMD and lime slurry. The lime slurry raised the pH of the AMD from 2.5 to approximately 2.8.

Increasing the pH had the desired effect of precipitating out 60 to 80 percent of the dissolved Fe (as $Fe[OH]_3$) and simultaneously co-precipitating over 90 percent of the As (as verified by field monitoring). The partially treated AMD then flowed by gravity from R-1 into a two-chambered, Phase 1 combination flash/flocculation mix tank. A polymer solution (Superfloc A-1849 RS Anionicpolyacrylamide water-in-oil emulsion) was injected into the partially treated AMD from R-1 in the flash mix portion of the Phase 1 flash/flocculation mix tank. In the flocculation mix portion of the tank, a low-speed mixer allowed the size of the floc particles containing the precipitated metals to increase. From the flocculation mix tank, the partially treated AMD flowed into a Lamella clarifier (CL-1) where the Phase 1 floc particles settled out.

Two 1.5-inch air diaphragm pumps transferred solids (Phase 1 sludge) from the bottom of CL-1 to one of two 8,500 gallon cone-bottom holding tanks (T-3A/B). A 1.5-inch air diaphragm pump then transferred the solids from the T-3A/B tanks to the Phase 1 pneumatic filter press (FP-1). FP-1 was positioned such that the filter cakes generated would drop directly into 20-cubic yard roll-off bins. When full, the bins were pulled from underneath the filter press, stored on site, and eventually transported off site for disposal at a Class 1 hazardous waste facility in Beatty, Nevada.

Supernatant from CL-1 flowed by gravity to the Phase 2 reaction tank (a second 10,000-gallon fiberglass tank) referred to as R-2. A pH probe in R-2 measured pH and controlled the amount of lime slurry added to R-2. A 7.5-hp mixer on R-2 mixed the partially treated AMD and lime slurry. In R-2, the lime slurry raised the pH of the partially treated AMD to approximately 8.5, which caused all but trace amounts of remaining metals to precipitate out of solution.

Treated AMD then flowed through the Phase 2 flash/flocculation mix tank and into the Phase 2 Lamella clarifier (CL-2). Two 10-hp mud pumps transferred the water/solid mixture from the bottom of CL-2 to the Pit Clarifier. Polymer solution (Superfloc A-1849 RS Anionicpolyacrylamide water-in-oil emulsion) was injected into the sludge slurry line just upstream of the two 10-hp mud pumps.

The Pit Clarifier is an earthen reservoir located in the Leviathan Mine open pit. The Pit Clarifier has plan dimensions of approximately 150-feet by 150-feet, and includes a perforated pipe and gravel/sand under-drain. During normal operations, the sludge slurry from CL-2 was pumped to the Pit Clarifier. Solids were allowed to settle out in near-quiescent conditions. Clean water was decanted from the Pit Clarifier via an adjustable outlet and conveyed by gravity to a weir box used for final effluent monitoring and discharge. If discharge from the Pit Clarifier was found to be out of compliance (by field analysis or direct knowledge of system upset), a valve prior to the weir box was used to divert the discharge back to Pond 1 for re-treatment. Once treatment ended, and discharge through the adjustable outlet (decant outlet) ended, treated water was then discharged via the Pit Clarifier under-drain and the weir box. Daily sampling of the discharge from the under-drain occurred until the flow rate out of the under-drain dropped below 1 gpm.

3.3 Effluent and Sludge Sampling

All sampling and analysis associated with biphasic treatment of pond water was performed in accordance with the RWQCB's *Sampling and Analysis Plan for Leviathan Mine Site Pond Water Treatment (August 2004)*. In accordance with the RWQCB's 2004 Work Plan, RWQCB staff collected daily grab samples of treated effluent while water was being discharged to Leviathan Creek. RWQCB staff also collected and analyzed samples of the influent AMD (pond water) approximately once per week when the treatment plant was in operating.

RWQCB staff collected grab samples of Phase 1 sludge from the bin beneath the Phase 1 filter press, combined the grab samples to form a composite sample, and shipped the composite samples to the RWQCB's contract laboratory for analysis. Phase 2 sludge was sampled directly from the Pit Clarifier following dewatering of the Pit Clarifier in November 2004.

3.4 Effluent Analysis

Laboratory Analysis: As a means to demonstrate that the treatment system was providing acceptable effluent for discharge to Leviathan Creek, RWQCB staff collected a daily grab sample of the treated effluent. A portion of the grab sample was field filtered and acid fixed, and submitted to the RWQCB's contract laboratory to be analyzed for dissolved aluminum (Al), arsenic (As), copper (Cu), chromium (Cr), cadmium (Cd), nickel (Ni), iron (Fe), lead (Pb), and zinc (Zn). An unfiltered portion of the daily grab sample was acid fixed and submitted to be analyzed for Total Recoverable Selenium (Se).

The results of laboratory analysis are included in the *Data Summary Report for 2004 Pond Water Treatment* (Appendix ___). The subject results were generated by the RWQCB's contract laboratory by applying standard analytical methods to daily grab samples of treated effluent.

The 4-day arithmetic average concentration for nickel discharged to Leviathan Creek was exceeded for three days during system start-up. Minor system adjustments were made after receiving initial analytical reports from the contract laboratory. Following the preliminary adjustments, the treatment plant continued to operate without exceeding discharge criteria for the remainder of the season.

Once per week, RWQCB staff submitted samples of treated effluent and samples of untreated influent for the following analysis: sulfate (SO_4), total dissolved solids, hardness as $CaCO_3$, dissolved Al, As, Cu, Cr, Cd, Ni, Fe, Pb, Zn, calcium (Ca), manganese (Mn), magnesium (Mg) (metals by Method 200.7 or 200.8), and Total Recoverable Se. The *Data Summary Report for 2004 Pond Water Treatment* contains the analytical results for untreated influent.

Field Analysis: To provide "real-time" information regarding metals concentrations and other parameters in the treated effluent, each day that the system was discharging to Leviathan Creek, RWQCB staff collected and field-analyzed at least two grab samples of the effluent for pH, dissolved As, Al, and Fe. The results of field analytical work are available from the RWQCB, but have not been included in this report. pH measurements taken in the field confirm that the discharge of treated effluent to Leviathan Creek was within USEPA's discharge criteria throughout the project.

3.5 Sludge Analysis

RWQCB staff sampled sludge generated in both Phase 1 and Phase 2 of the biphasic process. The sludge samples were analyzed by the RWQCB's contract laboratory, according to appropriate analytical procedures, to provide comparisons with the Total Threshold Limit Concentration (TTLC) and the Soluble Threshold Limit Concentration (STLC) for various constituents. Results of Phase 1 and Phase 2 sludge analyses are contained in the *Data Summary Report for 2004 Pond Water Treatment*.

Phase 1: Sludge was sampled by collecting one grab sample following each filter press run. Phase 1 grab samples were stored in the field laboratory. After seven days of collecting Phase 1 grab samples, a composite sample was prepared in the field laboratory and sent to the contract laboratory for TTLC and STLC analysis for Title 22 Metals, and Al and Fe. Results of Phase 1 sludge analysis are documented in the *Data Summary Report for 2004 Pond Water Treatment*. With the exception of the TTLC for As, Phase 1 sludge did not exceed any other STLC or TTLC limits.

Phase 2: Sludge was sampled directly from the Pit Clarifier following de-watering of the Pit Clarifier (via the under-drain) in November 2004. The collection of Phase 2 sludge samples occurred following dewatering of the sludge, approximately 4 months after the biphasic treatment system was shutdown. At the time of sampling, there was no discharge from the Pit Clarifier under-drain.

The three grab samples from the Pit Clarifier did not contain constituents in excess of the TTLC thresholds. With exception of Ni in two of the three grab samples; constituents were not detected in excess of the applicable STLCs in the Phase 2 sludge. The STLC for Ni is 20 mg/L. Ni was detected in two of the three grab samples at concentrations of 31.2 mg/L and 28.4 mg/L.

Further analysis of Phase 2 sludge indicates that Ni can be rendered more stable (under the STLC) by incorporating additional lime into the Phase 2 sludge. As part of the effort to cleanout the Pit Clarifier during the 2005 field season, the RWQCB will incorporate additional lime into the sludge as necessary to render the sludge compliant with the STLC for Ni.

3.6 Summary

Implementation of pond water treatment in 2004 was consistent with the RWQCB's 2004 Work Plan. The RWQCB operated the biphasic treatment plant from mid-June 2004 through July 17, 2004. Approximately 5.9 million gallons of treated pond water were discharged to Leviathan Creek. The RWQCB's treatment effort combined with natural evaporation resulted in the pond system having a storage capacity of approximately 14 million gallons at the end of the treatment season (Pond 4 was being used by Atlantic Richfield Company [ARC] as part of their efforts to treat other sources of AMD).

The 2004 treatment effort generated approximately 91 cubic yards (wet volume) of Phase 1 sludge and approximately 700 cubic yards (wet volume) of Phase 2 sludge. Phase 1 sludge was disposed of at a Class 1 hazardous waste facility in Beatty, Nevada. Phase 2 sludge was contained in the Pit Clarifier. The 2004 treatment effort consumed approximately 78.4 dry standard tons of lime ($Ca[OH]_2$), 3250 gallons of polymer, 4,020 gallons of diesel fuel and 715 gallons of gasoline.

There remain some unavoidable issues mostly related to the remoteness of the mine site. The remote location results in logistical obstacles for the delivery of: 1) hardware items for system setup and maintenance (pipes, valves, controls, etc.), and 2) consumables for plant operation (lime, fuel, etc.). Rough road conditions can also hamper site access. RWQCB staff is working with the USFS and ARC to improve road conditions along the California road (see Site Maintenance section for more information).

4. SITE MONITORING

The RWQCB continued their efforts to monitor surface water flow and water quality, and to collect meteorological information in the vicinity of Leviathan Mine.

4.1 Flow Monitoring

Flow monitoring for the 2003-2004 water year (October 1, 2003 through September 30, 2004) at Leviathan Mine continued under contract between the RWQCB and the United States Geological Survey (USGS). Flow monitoring occurred as delineated in Table 6. Daily average flow data for stations with continuous recorders are included in Appendix 2. All flow data collected by the USGS are forwarded to ARC for incorporation into the Leviathan Mine database. Flow from the Channel Under-Drain (CUD) was directed into the ARC treatment system beginning in early June 2004, thus there was no flow from the CUD to the creek from that date until mid-October 2004.

Table 2. Flow Monitoring Locations

STATION LOCATION/DESCRIPTION	EQUIPMENT	USGS STARTUP DATE
Leviathan Creek above the mine **(Station 1)**	Continuous flow recorder and appurtenances, solar power supply.	October 98
Pit Under-Drain at the flow control structure **(PUD)**	Continuous flow recorder and appurtenances, solar power supply, telemetry.	October 99
Adit at the flow control Structure **(Adit)**	Continuous flow recorder and appurtenances, solar power supply, telemetry.	October 99
Pond 1 Stage	Continuous stage recorder and appurtenances, solar power supply, telemetry.	October 99
Channel Under-Drain **(CUD)**	Continuous flow recorder and appurtenances, solar power supply, telemetry.	October 99
Aspen Creek above the mine **(Station 22)**	Continuous flow recorder and appurtenances, solar power supply.	October 03
4L Creek above its confluence with Leviathan Creek **(Station 4L)**	Continuous flow recorder and appurtenances, solar power supply.	October 03
Leviathan Creek Above its confluence with Aspen Creek **(Station 15)**	Continuous flow recorder and appurtenances, solar power supply, telemetry.	October 98
Aspen Creek above its confluence with Leviathan Creek **(Station 16)**	None. Monthly flow measurements to establish relationship w/STA 15.	October 98
Overburden (Aspen) Seep, above the Bioreactors **(OS)**	Continuous flow recorder and appurtenances, solar power supply.	October 98
Bryant Creek just below the confluence of Mountaineer and Leviathan Creeks **(Station 25)**	Continuous flow recorder and appurtenances, solar power supply.	October 98
Leviathan Creek just above the confluence of Mountaineer and Leviathan Creeks **(Station 23)**	Continuous flow recorder and appurtenances, solar power supply	November 99
Mountaineer Creek just above the confluence of Leviathan and Mountaineer Creeks **(Station 24)**	None. Monthly flow measurements to establish relationship w/STA 23.	December 99
Bryant Creek just above confluence with Doud Springs **(Station 26)**	Continuous flow recorder and appurtenances, solar power supply	August 01

4.2 Surface Water Monitoring

The RWQCB continued monthly water quality monitoring through the 2003-2004 water year (October 1, 2003 through September 30, 2004). The RWQCB's monthly surface water quality monitoring stations and parameters are summarized in Table 7. Until January 2004, surface water sampling and analysis was performed in accordance with the RWQCB's *Draft Quality Assurance Project Plan (QAPP) for Surface Water Quality Monitoring at Leviathan Mine Superfund Site (March 2002).* Starting January 2004, surface water sampling and analysis was done in compliance with the *Sampling and Analysis Plan for Leviathan Mine Site Surface Water Monitoring (January 2004)* (SAP), (these documents are not included in this report, but copies may be obtained from the RWQCB). Surface water data collected by the RWQCB is forwarded to ARC for input into the Leviathan Mine database. All of the surface water data collected for this water year is summarized in the Data Summary Report, included as Appendix 3.

Semi-annual sampling at Station 4L began in October 2003 to coincide with installation of the USGS continuous flow recorder at this location. Semi-annual monitoring of the Delta Seep was added in January 2004 as part of the SAP, and was sampled in the May with the other semi-annual sites. In addition to the routine samples, several other minor acidic seeps were also sampled in the Spring 2004 including the "Overburden Upper Seep," (OUS) and the "Crusher Road Seep" (CRS), and "Station 15 Seep" (Sta 15 Seep).

Table 3. Surface Water Quality Sampling Stations

RWQCB Station	Site Description	Sampling Frequency	Parameters Measured
Station 1	Leviathan Creek above Leviathan Mine.	Monthly	Total and Dissolved Metals for Al, As, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Ni, Zn; Total Dissolved Solids (TDS); Sulfate; field: pH, temperature, electrical conductivity, and specific conductance.
Adit	Drainage from Tunnel #5 (the Adit), prior to entering evaporation ponds.	Monthly	Same as above.
Pit Under - Drain (PUD)	Drainage from shallow ground water collection pipes in pit, prior to entering evaporation ponds.	Monthly	Same as above.
Channel Under-Drain (CUD)	Discharge from Channel Under-Drain below Leviathan Creek concrete channel.	Monthly	Same as above.
Delta Seep (DS)	Seepage from the toe of the Delta Slope, located north of Pond 4.	Semi-annual	Same as above.
Station 15	Leviathan Creek, above the confluence of Leviathan and Aspen creeks.	Monthly	Same as above.
Station 16	Aspen Creek, above the confluence of Leviathan and Aspen creeks.	Monthly	Same as above.
Station 4L	4L Creek, just above the confluence of Leviathan Creek.	Semi-annual	Same as above.
Station 22	Aspen Creek above Leviathan Mine.	Monthly	Same as above.
Overburden Seep (OS)	Overburden seepage (a.k.a. Aspen Seep), above the bioreactors.	Monthly	Same as above.
Station 23	Leviathan Creek above the confluence of Leviathan and Mountaineer creeks.	Monthly	Same as above.
Station 24	Mountaineer above the confluence of Leviathan and Mountaineer creeks.	Monthly	Same as above.
Station 25	Bryant Creek below the confluence of Leviathan and Mountaineer creeks.	Monthly	Same as above.
Station 26	Bryant Creek above the confluence of Doud Springs and Bryant Creek.	Semi-annual	Same as above.

4.3 Meteorological Monitoring

The weather station located on the RWQCB's construction trailer near Pond 1, a Davis Integrated Sensor Suite, has been operational since installation in November 2002. The system measures the following conditions: wind speed, wind direction, rainfall, outside temperature, outside humidity, ultraviolet radiation, and solar radiation. RWQCB staff downloaded data from this weather station semi-annually and transmitted the data to ARC for incorporation into the master database for Leviathan Mine.

5. SITE MAINTENANCE

The RWQCB conducted site maintenance work during the 2004 field season in accordance with the *2004 Site Maintenance Work Plan*. These activities are necessary to prevent failures and to ensure proper performance of the 1985 pollution abatement system. Routine maintenance activities include repairing perimeter fencing, removing sediment from storm water ditches, covering exposed pond liners, minor road repair, and assessing/repairing pond liners and plumbing.

5.1 Repairing Perimeter Fencing

A barbed wire fence surrounds the state-owned portion of Leviathan Mine (approximately). During the 2004 field season, RWQCB staff inspected the entire fence line and repaired numerous sections. Several trees had fallen across the perimeter fencing and across the site access road near the California gate. RWQCB staff removed the fallen trees and repaired the fence at this location in the early part of the 2004 field season. By late June 2004, the fence was continuous around the entire site. Selected areas of the perimeter fencing were reinforced, and a fourth strand of barbed wire installed where cattle have been known to congregate and occasionally access the site. No cattle were observed inside the perimeter fence during the 2004 field season.

5.2 Storm Water Conveyance and Road Maintenance

In the fall of 2004, the RWQCB hired a contractor to clean out portions of drainage ditches filled with sediment and improve drainage along roads known to have standing water in the late spring and early summer. In the latter part of the 2004 field season, the earthen ditch west of Pond 3 and along the east side of Pond 4 was cleaned out in an effort to prevent standing water south and east of Pond 4. Drainage north of the pond water treatment storage bins was improved to eliminate standing water following spring snowmelt. In addition, sediment was removed from the concrete v-ditches south of Pond 1 and east of Pond 3.

Significant progress has been made on the development of an agreement between the RWQCB, USFS, and ARC to conduct road maintenance and improvement work on USFS Road 052 (along the Highway 89 access route, between Highway 89 and Leviathan Mine). The maintenance work is scheduled to start May 2005 and to be completed by July 1, 2005. Work to be completed by the USFS includes resurfacing (asphalt concrete and/or base rock) the road at several locations along the California access route.

5.3 Covering Exposed Liner

RWQCB staff visually inspected cover material around each pond as a means to detect areas where earthen cover had eroded. The amount of exposed liner was considered to be minimal, and RWQCB staff placed material removed from storm water conveyances over exposed liner.

5.4 Repair of Booted Pipe Penetrations on Ponds 1, 2N, 2S, and 3

Under contract with the California Department of General Services (DGS), and on behalf of the RWQCB, a contractor was hired to repair the pipe penetrations on Ponds 1, 2N, 2S, and 3. An assessment of the boots was conducted in October 2002 and the results of the assessment were presented in Kleinfelder's January 8, 2003 report titled, "*Geomembrane Boot Inspection Report, Leviathan Mine Ponds, Alpine County, California.*" The report concluded that the geomembrane used to seal pipe penetrations to the pond liner were in need of repair and that the pond liner appears to be in good condition.

Under a competitively bid contract, repair work took place in the fall of 2004, when the water level in the ponds was at a low point for the season. The booted penetrations on Ponds 1, 2N, 2S, and 3 were replaced. In order to perform repairs to the Pond 3 inlet pipe penetration (from Pond 1 overflow), approximately 52 cubic yards of biphasic sludge were removed from the southern portion of Pond 3 and disposed of at the Beatty, NV disposal facility.

6. REVEGETATION

6.1 Seeding

Revegetation work at Leviathan Mine in 2004 consisted of spreading seed over material removed from the Leviathan Creek channel during cleanout operations performed at the end of the 2003 field season. A mixture of grass seed consisting of Wildrye, Wheatgrass, Indian Ricegrass, Squireltail and Barley was broadcast over the removed material prior to the first heavy snow in the fall of 2004.

6.2 Invasive Plant Control

The El Dorado County, Department of Agriculture (EDCDA) visited Leviathan Mine and applied herbicide (telar) on invasive plants in June 2004. This year (2004), as in 2003 and 2002, the EDCDA sprayed for tall whitetop (Lepidium latifolium).